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Docket No.: 2427/207-104


Xiomara D. JUNCO

Date: August 23, 1999

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Enclosed herewith are the necessary papers for filing the following application for Letters Patent:

Applicant : FRIEDHELM BECKMANN

Title : MULTILAYER COMPOSITE BODY

2 sheets of formal drawings in triplicate.

A check in the amount of \$380.00 covering the filing fee.

PCT Publication (cover sheet only).

This application is being filed without a signed oath or declaration under the provisions of 37 CFR 1.53(d). Applicants await notification of the date by which the oath or declaration and the surcharge are due, pursuant to this rule.

The Patent and Trademark Office is hereby given authority to charge Deposit Account No. 12-1099 of Lerner and Greenberg, P.A. for any fees due or deficiencies of payments made for any purpose during the pendency of the above-identified application.

Respectfully submitted,



For Applicant
LAG:tg

08/23/99 09:37:21

MULTILAYER COMPOSITE BODY5 Cross-Reference to Related Application:

This application is a continuation of copending International Application No. PCT/DE98/00015, filed January 7, 1998, which designated the United States.

10 Background of the Invention:Field of the Invention:

15 The invention relates to a multilayer composite body including thermoplastic layers and layers of natural fiber bound with thermoplastic synthetic materials, for the fabrication of components or preforms, especially for motor vehicles.

Components formed from natural fibers, for example jute, hemp, sisal, flax and the like, or from mixtures of natural fibers, are already known. In order to fabricate the components, the

20 natural fibers are mixed with fibers of thermoplastic synthetic material or the natural fibers are impregnated directly with a thermoplastic bonding agent and preformed into fiber mats which are then brought to the required shape by pressing in a die at a molding temperature above the melting
25 temperature of the synthetic material being used. After cooling and solidification of the synthetic material a rigid,

solid component is obtained with the appropriate three-dimensional shape.

Due to the low thermal stability of the natural fibers which
5 can suffer damage at high temperatures, the bonding agents
which are used are in the form of synthetic fibers or
impregnation thermoplastic or low-melting duroplastic
synthetic materials such as polypropylene, polyethylene,
ethylene vinyl acetate and the like, having a melting
10 temperature which must not exceed or must be only slightly
higher than 250°C. However, the mechanical properties which
can be achieved with composite materials of that kind often do
not satisfy strength requirements set for the respective
components.

15 A one-piece multilayer composite body was already proposed in
German Published, Non-Prosecuted Patent Application DE 44 03
977 A1 in order to raise the strength of components fabricated
by using natural fibers and to improve molding characteristics
20 of the starting material being formed of fiber mats. That
composite body essentially is formed of a supporting layer
with natural fibers embedded therein, and an outer layer of
thermoplastic synthetic material covering it on each side with
glass fibers bonded therein. In addition, that composite body
25 made from combining individual thermoplastic layers is covered
at one outer surface with a layer of foam and a decorative

layer of a fabric. With that construction and that configuration of layers it is not possible to achieve an intimate, one-piece bonding between the layers and, in particular, a high flexural strength and impact resistance which is often specifically demanded of motor vehicles.

Summary of the Invention:

It is accordingly an object of the invention to provide a multilayer composite body of synthetic material, fabricated with the use of natural fibers, which overcomes the hereinafore-mentioned disadvantages of the heretofore-known devices of this general type and which is constructed in such a way as to enable a component fabricated therefrom to meet specifications set for its mechanical properties, especially with respect to flexural strength and impact resistance.

With the foregoing and other objects in view there is provided, in accordance with the invention, a multilayer composite body for the production of components or preforms, especially for motor vehicles, comprising thermoplastic layers; natural fiber layers bonded with thermoplastic synthetic material; and at least one reinforcing insert adjacent the thermoplastic layers and the natural fiber layers, the at least one reinforcing insert having an open-pored fabric formed from fibers, the fabric penetrated or impregnated from at least one side by melting synthetic

materials of the adjacent natural fiber layers and/or the adjacent thermoplastic layers and the natural fiber layers and/or the thermoplastic layers, integrated or bonded into the fabric for reinforcement.

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Thus the basic concept of the invention resides in the configuration of a high-strength fabric melting towards the synthetic material becoming molten during the molding, into which fabric the molten synthetic material penetrates from both sides. As a result of the reinforcing effect of the fabric, the strength characteristics are considerably improved and at the same time an intimate bond is formed over the fabric insert between adjacent layers of low-melting synthetic materials with or without natural fibers.

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Thus it is possible, through the use of the reinforcing inserts of fabric, to provide composite-body components which can be fabricated in a simple way and which have good mechanical properties, in particular a high flexural strength and impact resistance.

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On one hand, each reinforcing insert is advantageously disposed between two layers of natural fiber bonded in thermoplastic synthetic material. This composite in particular enables outstanding strength characteristics to be achieved for the composite body.

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On the other hand, however, it is also possible to fabricate composite bodies in which the reinforcing insert lies between a pure thermoplastic layer and a layer of natural fibers

5 bonded with synthetic material, or it can even be disposed between two layers of thermoplastic.

In advantageous embodiments of the invention the composite body can also contain two or more reinforcing inserts of

10 fabric. However, in each case the inserts are disposed between two layers containing a low-melting synthetic material.

15 In accordance with another feature of the invention, the synthetic material of the thermoplastic layers and the natural fiber layers has a melting temperature of $< 250^{\circ}\text{C}$.

20 In accordance with a further feature of the invention, the synthetic material of the thermoplastic layers and the natural fiber layers is selected from the group consisting of polyethylene, polypropylene and ethylene vinyl acetate.

In accordance with an added feature of the invention, the natural fiber layers contain natural fibers formed from the
25 group consisting of flax, hemp, sisal, jute and mixtures thereof.

In accordance with an additional feature of the invention, the fibers of the fabric of the reinforcing insert are formed of melted synthetic materials selected from the group consisting of polyethylene terephthalate, polybutylene terephthalate, glass fibers, carbon fibers and a combination of different melted fibers.

In accordance with yet another feature of the invention, the at least one reinforcing insert is centrally disposed and has outer surfaces; the natural fiber layers are first and second natural fiber layers disposed at the outer surfaces of the at least one reinforcing insert and having outer surfaces; the thermoplastic layers are first and second thermoplastic layers covering and bonded with the outer surfaces of the first and second natural fiber layers as an outer layer; and the thermoplastic synthetic bonding material of the natural fiber layers simultaneously penetrates the fibers of the fabric of the at least one reinforcing insert and the first and second thermoplastic layers.

In accordance with yet a further feature of the invention, the at least one reinforcing insert includes first, second and third reinforcing inserts; the first reinforcing insert is disposed between the first and second natural fiber layers; the second reinforcing insert is disposed between the first

natural fiber layer and the first thermoplastic layer; the third reinforcing insert is disposed between the second natural fiber layer and the second thermoplastic layer; and the second and third reinforcing inserts are bonded into the thermoplastic material of the adjacent natural fiber and thermoplastic layers.

In accordance with yet an added feature of the invention, the thermoplastic layers are formed of a material selected from the group consisting of film material and fiber material becoming molten during molding of a component.

In accordance with yet an additional feature of the invention, the thermoplastic layers have a variable volume and form outer component surfaces, and at least one of molded-in functional elements and surface structures are disposed in the outer component surfaces and correspond to the variable volume.

In accordance with again another feature of the invention, the thermoplastic layers are self-colored.

In accordance with again a further feature of the invention, the thermoplastic layers have outer surfaces, and covering layers are bonded with the outer surfaces.

In accordance with a concomitant feature of the invention, the

at least one reinforcing insert has a higher melting point than the thermoplastic.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in a multilayer composite body, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

Brief Description of the Drawings:

Fig. 1 is a diagrammatic, perspective view of a mat with an externally located reinforcing fabric on both sides;

Fig. 2 is a perspective view of an edge section of a natural fiber/thermoplastic fiber mat with a single reinforcing insert of open-pored fabric;

Fig. 3 is a perspective view of a further embodiment of a fiber mat with three reinforcing inserts for a composite body to be formed; and

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Fig. 4 is a perspective view of a fiber mat according to Fig. 2 but with a covering film disposed in addition on each side.

Description of the Preferred Embodiments:

10 Referring now to the figures of the drawing in detail, it is noted that in order to make every layer visible in perspective views, fiber mats in exemplary embodiments shown herein are illustrated with a strip cut away from an edge of each individual strip relative to a strip lying adjacent it. A
15 diagrammatic illustration of the fiber mat which forms a starting material for a composite body to be formed or a molded component is identical with that of a composite body.

In a basic embodiment according to Fig. 1, a natural fiber
20 layer 2.1 is covered on each side by a respective reinforcing fabric 3.1, 3.2. According to Fig. 2, a fiber mat or composite body includes first and second thermoplastic layers of fibers 1.1 and 1.2 as outer layers respectively covering two sides of the composite body. Polypropylene, polyethylene
25 or ethylene vinyl acetate may, for example, be used as the thermoplastic fiber material. A first and a second layer of

natural fibers 2.1 and 2.2 are located adjacent an inner surface of each respective outer first and second thermoplastic layer 1.1 and 1.2. The natural fiber layers 2.1 and 2.2 are formed of natural fibers such as hemp, flax, jute, sisal and the like, or a mixture of natural fibers, which are impregnated with a bonding agent of thermoplastic synthetic material or mixed with corresponding fibers that form a composite with the bonding agent after molding.

A middle layer embedded between the two natural fiber layers 2.1 and 2.2 is a reinforcing insert 3 of open-structured fabric which is formed of a fiber material with a higher melting temperature than that of the thermoplastic bonding agent used for the natural fiber layers 2.1 and 2.2. In the exemplary embodiment, the wide-pored fabric of the reinforcing insert 3 is formed of polyester fibers. It is also possible, for example, to use fibers of polybutylene terephthalate or carbon fibers or glass fibers or a combination of these or other high-melting fibers.

The fiber mat which is thus formed is then molded to the required composite body component, for example for use in motor vehicle manufacture. This is done in such a way that the fiber mat is heated to a temperature of approximately 200°C in the melting temperature range of the thermoplastics being used and is pressed into a required shape.

The volume of the first and second thermoplastic layers 1.2 and 1.1 lying at the outer surfaces of the natural fiber layers 2.1 and 2.2 is selected in such a way that during the pressing process functional elements such as fixing strips, ribs or the like, or specific visually effective surface structures, can be formed at these layers. In the same way it is possible to provide special coloration of the first and second thermoplastic layers 1.1 and 1.2 for aesthetic reasons.

While the heated fiber mat is being pressed, the low-melting, molten thermoplastics of the natural fiber layers 2.1 and 2.2 penetrate into the wide-meshed fabric structure of the reinforcing insert 3 from both sides and coat the fabric of the reinforcing insert 3. A tight composite thus arises with the adjacent natural fiber layers 2.1 and 2.2 in which the fabric acts as a reinforcement. As a result, the mechanical properties of the component that is fabricated in this way are considerably improved, especially with respect to flexural strength and impact resistance.

Fig. 3 shows a second embodiment of a fiber mat for fabrication of components with further improved reinforcing properties as compared with the first embodiment, through the use of first, second and third reinforcing inserts 3.1, 3.2 and 3.3. The fiber mat which includes several layers is

formed of a consecutive repeating sequence of a first thermoplastic layer 1.1, the second reinforcing insert 3.2, a first natural fiber layer 2.1, the first reinforcing insert 3.1, a second natural fiber layer 2.2, the third reinforcing insert 3.3 and a second thermoplastic layer 1.2.

Upon heating and pressing a fiber mat which is formed in this way from individual layers, the molten thermoplastic material of the first and second thermoplastic layers 1.1, 1.2 and the first and second natural fiber layers 2.1, 2.2 respectively penetrate from both sides into the open-pored fabric structure of the higher-melting-fiber reinforcing inserts 3.1, 3.2 and 3.3. The penetration thus forms a multilayer reinforcement of a sandwich-type one-piece composite body in the component which is formed in this way and contributes to a considerable increase in strength characteristics. Depending on the thickness of the outer layers of the composite body formed from the thermoplastic layers 1.1 and 1.2, specific functional elements and surface structures can also be formed at these layers during pressing.

The embodiment according to Fig. 4 essentially corresponds to the embodiment described with regard to Fig. 3. However, in this case the outer surfaces of the fiber mat or the component being formed of a composite body are additionally provided with a covering film 4.1 and 4.2 or other decorative

materials, e.g. for improving the visual characteristics.

I claim:

1. A multilayer composite body for the production of components or preforms, comprising:

thermoplastic layers having synthetic materials;

natural fiber layers bonded with thermoplastic synthetic material; and

at least one reinforcing insert adjacent said thermoplastic layers and said natural fiber layers, said at least one reinforcing insert having an open-pored fabric formed from fibers, said fabric penetrated from at least one side by melted synthetic materials of at least one of said adjacent natural fiber layers and said adjacent thermoplastic layers integrated into said fabric for reinforcement.

2. The multilayer composite body according to claim 1, wherein said synthetic material of said thermoplastic layers and said natural fiber layers has a melting temperature of < 250°C.

3. The multilayer composite body according to claim 1, wherein said synthetic material of said thermoplastic layers and said natural fiber layers is selected from the group

consisting of polyethylene, polypropylene and ethylene vinyl acetate.

4. The multilayer composite body according to claim 1, wherein said natural fiber layers contain natural fibers formed from the group consisting of flax, hemp, sisal, jute and mixtures thereof.

5. The multilayer composite body according to claim 1, wherein said fibers of said fabric of said reinforcing insert are formed of melted synthetic materials selected from the group consisting of polyethylene terephthalate, polybutylene terephthalate, glass fibers, carbon fibers and a combination of different melted fibers.

6. The multilayer composite body according to claim 1, wherein:

said at least one reinforcing insert is centrally disposed and has outer surfaces;

said natural fiber layers are first and second natural fiber layers disposed at said outer surfaces of said at least one reinforcing insert and having outer surfaces;

said thermoplastic layers are first and second thermoplastic

layers covering and bonded with said outer surfaces of said first and second natural fiber layers as an outer layer; and

said thermoplastic synthetic bonding material of said natural fiber layers simultaneously penetrates said fibers of said fabric of said at least one reinforcing insert and said first and second thermoplastic layers.

7. The multilayer composite body according to claim 6, wherein:

said at least one reinforcing insert includes first, second and third reinforcing inserts;

said first reinforcing insert is disposed between said first and second natural fiber layers;

said second reinforcing insert is disposed between said first natural fiber layer and said first thermoplastic layer;

said third reinforcing insert is disposed between said second natural fiber layer and said second thermoplastic layer; and

said second and third reinforcing inserts are bonded into said thermoplastic material of said adjacent natural fiber and thermoplastic layers.

8. The multilayer composite body according to claim 1, wherein said thermoplastic layers are formed of a material selected from the group consisting of film material and fiber material becoming molten during molding of a component.

9. The multilayer composite body according to claim 1, wherein said thermoplastic layers have a variable volume and form outer component surfaces, and at least one of molded-in functional elements and surface structures are disposed in said outer component surfaces and correspond to said variable volume.

10. The multilayer composite body according to claim 1, wherein said thermoplastic layers are self-colored.

11. The multilayer composite body according to claim 1, wherein said thermoplastic layers have outer surfaces, and covering layers are bonded with said outer surfaces.

12. The multilayer composite body according to claim 1, wherein said at least one reinforcing insert has a higher melting point than said thermoplastic.

13. A motor vehicle component or preform produced from a multilayer composite, comprising:

thermoplastic layers having synthetic materials;

natural fiber layers bonded with thermoplastic synthetic material; and

at least one reinforcing insert adjacent said thermoplastic layers and said natural fiber layers, said at least one reinforcing insert having an open-pored fabric formed from fibers, said fabric penetrated from at least one side by melted synthetic materials of at least one of said adjacent natural fiber layers and said adjacent thermoplastic layers integrated into said fabric for reinforcement.

Abstract of the Disclosure:

A multilayer composite body includes thermoplastic layers and layers of natural fibers bound with thermoplastic synthetic material. The composite body has at least one reinforcing layer made of an open-cell fabric of melting fibers. The reinforcing layer is penetrated on one or both sides by the melting thermoplastic synthetic material of adjoining natural-fiber layers and is integrated there for reinforcement. The reinforcing layer can also be disposed in addition or only between natural-fiber and pure thermoplastic layers or between thermoplastic layers. Such a composite body has excellent mechanical properties, in particular with regard to bending stress and impact resistance.

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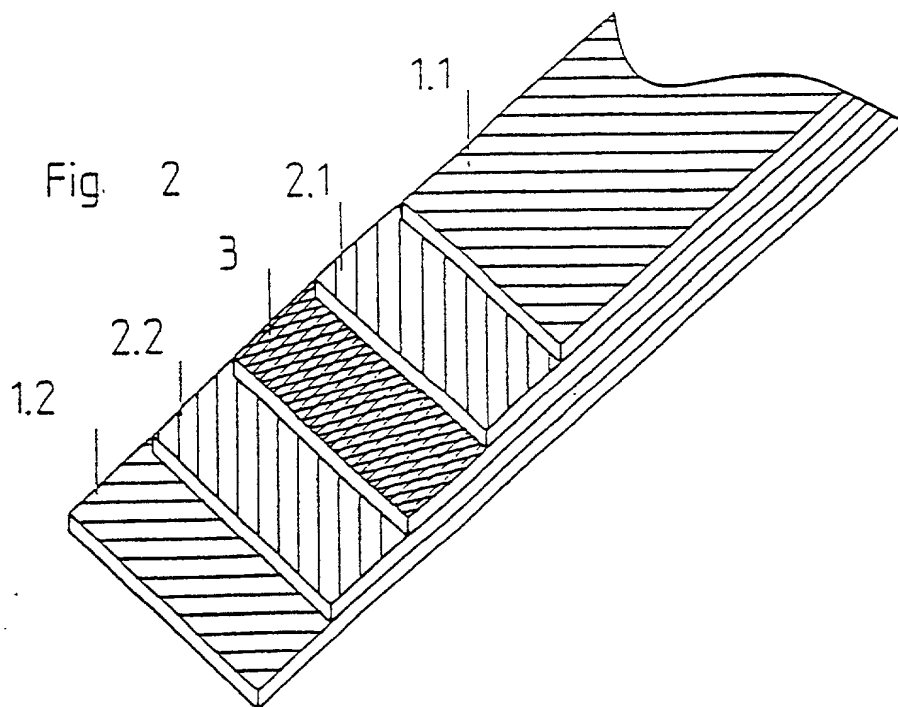
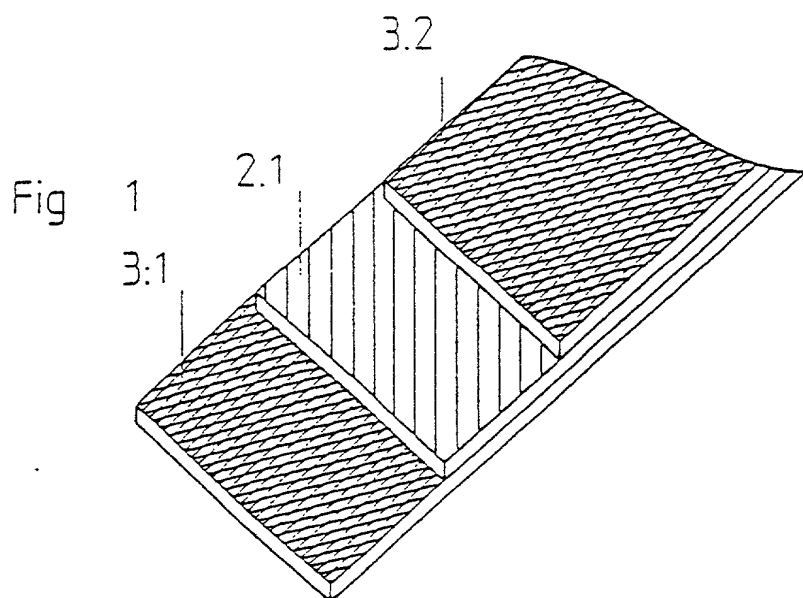


Fig. 3

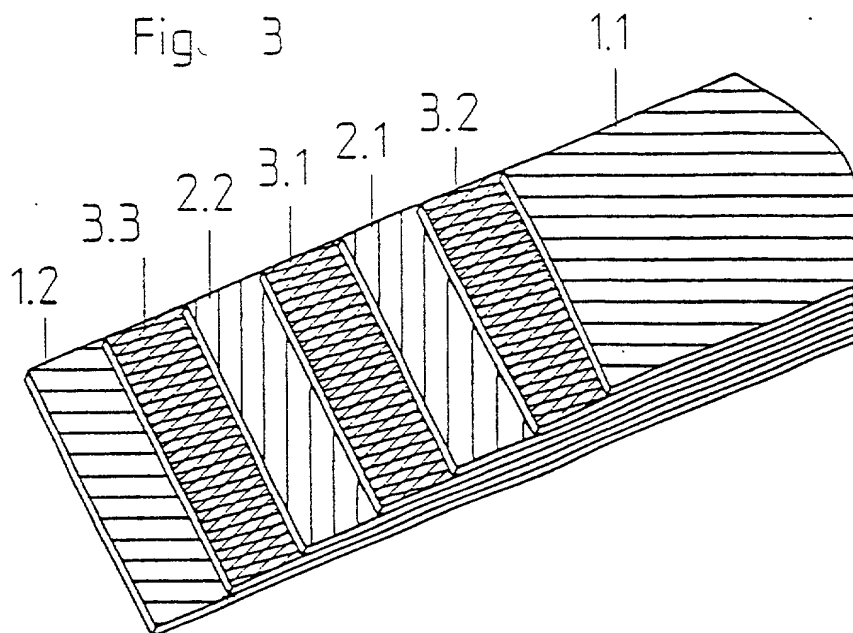
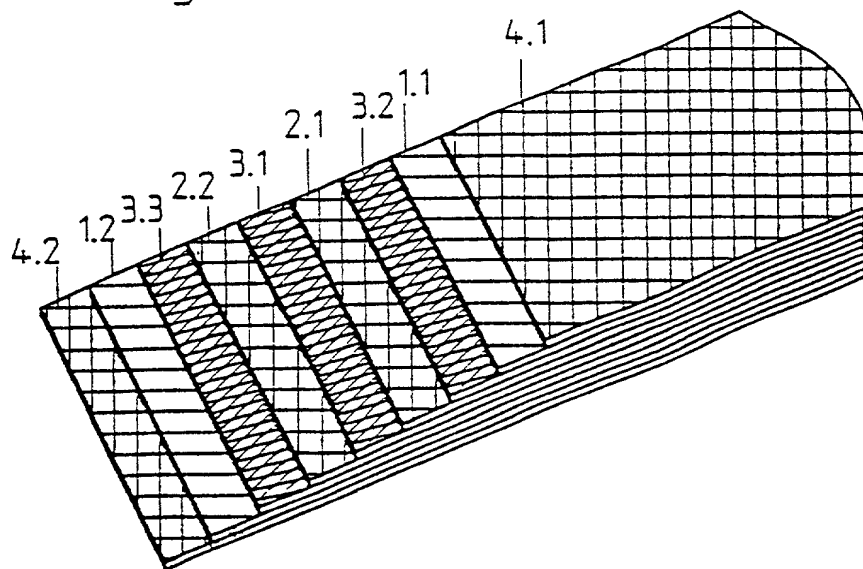


Fig. 4



COMBINED DECLARATION AND POWER OF ATTORNEY
IN ORIGINAL APPLICATION

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MULTILAYER COMPOSITE BODY

described and claimed in the specification bearing that title, that I understand the content of the specification, that I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve month prior to this application, that I acknowledge my duty to disclose information of which I am aware which is material to the examination of this application under 37 C.F.R. 1.56a, and that no application for patent or inventor's certificate of this invention has been filed earlier than the following in any country foreign to the United States prior to this application by me or my legal representatives or assigns:

German Application No. 197 06 839.1, filed February 21, 1997, the International Priority of which is claimed under 35 U.S.C. § 119; and International Application No. PCT/DE98/00015, filed January 7, 1998, the Priority of which is claimed under 35 U.S.C. §120.

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

HERBERT L. LERNER (Reg.No.20,435)
LAURENCE A. GREENBERG (Reg.No.29,308)
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I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE INVENTOR:

FRIEDHELM BECKMANN

INVENTOR'S SIGNATURE: _____

DATE: _____

Residence: HIDDENHAUSEN, GERMANY

Country of Citizenship: GERMANY

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GERMANY

Attorney's Docket No: 2427/207-104
Applicant: FRIEDHELM BECKMANN
Filed : Concurrently herewith
Title : MULTILAYER COMPOSITE BODY

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(F) AND 1.27(B)) - INDEPENDENT INVENTOR

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled MULTILAYER COMPOSITE BODY described in the specification filed herewith.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e). Each person, concern or organization to which I have assigned, granted, conveyed, or licensed, or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☐ no such person, concern, or organization:
☒ persons, concerns or organizations listed below:

Full Name of Concern Möller Plast GmbH
Address of Concern Kupferhammer, 33649 Bielefeld, Germany
☐ Individual ☒ Small Business Concern ☐ Nonprofit Organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

FRIEDHELM BECKMANN

Name of Inventor

Signature of the Inventor

Date

Attorney's Docket No: 2414/207-101

Applicant: FRIEDHELM BECKMANN

Filed : Concurrently herewith

Title : MULTILAYER COMPOSITE BODY

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am

- ☐ the owner of the small business concern identified below:
- ☐ an official of the small business concern empowered to act
on behalf of the concern identified below:

Name of Small Business Concern Möller Plast GmbH

Address of Concern Kupferhammer, 33649 Bielefeld, Germany

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third-party or parties controls or has the power to control both.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights in the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who would not qualify as a independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

DATE: _____

[illegible]